

WHAT IS CLAIMED IS:

- 1 1. A primary lithium electrochemical cell comprising:
2 a cathode including lambda-manganese dioxide;
3 an anode including lithium;
4 a separator between the anode and the cathode; and
5 an electrolyte contacting the cathode, the anode and the separator,
6 wherein the cell has an average closed circuit voltage of about between about 3.8 and
7 4.1V and a specific discharge capacity to a 3V cutoff of greater than 130 mAh/g at a nominal
8 discharge rate of 1 mA/cm².

- 1 2. The electrochemical cell of claim 1, wherein the cell has a 3V cutoff of greater
2 than 135 mAh/g.

- 1 3. The electrochemical cell of claim 1, wherein the cell has a 3V cutoff of 140
2 mAh/g or greater.

- 1 4. The electrochemical cell of claim 1, wherein the lambda-manganese dioxide is
2 maintained at a temperature of less than 150°C during processing or cathode fabrication.

- 1 5. The electrochemical cell of claim 1, wherein the cathode containing the lambda-
2 manganese dioxide is maintained at a temperature of 120°C or less during processing or
3 fabrication.

- 1 6. The electrochemical cell of claim 1, wherein the lambda-manganese dioxide has a
2 BET surface area of greater than 4 m²/g.

- 1 7. The electrochemical cell of claim 1, wherein the lambda-manganese dioxide has a
2 BET surface area of greater than 8 m²/g.

- 1 8. The electrochemical cell of claim 1, wherein the lambda-manganese dioxide has a
2 total pore volume of from 0.05 to 0.15 cubic centimeters per gram.

1 9. A primary lithium electrochemical cell comprising:
2 a cathode including lambda-manganese dioxide having a total pore volume of greater
3 than 0.11 cubic centimeters per gram, and the lambda-manganese dioxide has a BET surface
4 area of greater than $8 \text{ m}^2/\text{g}$, wherein the lambda-manganese dioxide is maintained during
5 processing at a temperature of 120°C or less;
6 an anode including lithium or a lithium alloy;
7 a separator between the anode and the cathode; and
8 an electrolyte contacting the cathode, the anode and the separator,
9 wherein the cell has an average closed circuit voltage of about 4V, a specific
10 discharge capacity to a 3V cutoff of greater than 130 mAh/g at a nominal discharge rate of 1
11 mA/cm².

1 10. The electrochemical cell of claim 9, wherein the cell has a 3V cutoff of 135
2 mAh/g or greater at a nominal discharge rate of 0.4 mA/cm².

1 11. A method of preparing lambda-manganese dioxide comprising:
2 contacting water with a compound of the formula $\text{Li}_{1+x}\text{Mn}_{2-x}\text{O}_4$, wherein x is from
3 -0.02 to +0.02;
4 adding an acid to the water and compound until the water has a pH of 1 or less;
5 separating a solid from the water and acid; and
6 drying the solid at a temperature of 120°C or below to obtain the lambda-manganese
7 dioxide.

1 12. The method of claim 11, wherein the compound has a BET surface area of
2 between 1 and 10 m²/g.

1 13. The method of claim 11, wherein the compound has a spinel-type crystal
2 structure.

1 14. The method of claim 11, wherein the solid is dried at a temperature between 30°C
2 to 90°C.

1 15. The method of claim 11, wherein the solid is dried at a temperature between 50°C
2 and 70°C.

1 16. The method of claim 11, wherein x is from -0.005 to +0.005.

1 17. The method of claim 11, wherein contacting water and the compound includes
2 forming a slurry.

1 18. The method of claim 17, wherein the slurry is maintained at a temperature below
2 50°C.

1 19. The method of claim 11, wherein the acid sulfuric acid, nitric acid, perchloric
2 acid, hydrochloric acid, toluenesulfonic acid or trifluoromethylsulfonic acid.

1 20. The method of claim 17, wherein the temperature of the slurry is held
2 substantially constant during the addition of acid.

1 21. The method of claim 11, wherein the pH is 0.7 or less.

1 22. The method of claim 11, wherein the acid has a concentration of between 1 and 8
2 molar.

1 23. The method of claim 11, further comprising washing the solid separated from the
2 liquid phase with water until the washings have a pH of between 6 and 7.

1 24. A method of manufacturing an electrochemical cell comprising:
2 providing an positive electrode including a lambda-manganese oxide; and
3 forming a cell including the electrode and a lithium negative electrode,
4 wherein the cell has a closed circuit voltage of about 4V and a specific discharge
5 capacity at a nominal discharge rate of 1 mA/cm² to a 3V cutoff of greater than 120 mAh/g.

1 25. The method of claim 24, wherein providing the electrode includes preparing
2 lambda-manganese dioxide by a method comprising:

3 contacting water with a compound of the formula $\text{Li}_{1+x}\text{Mn}_{2-x}\text{O}_4$, wherein x is from
4 -0.02 to +0.02;

5 adding an acid to the water and compound until the water has a pH of 1 or less;

separating a solid from the water and acid; and

7 drying the solid at a temperature of 120°C or below to obtain the lambda-manganese
8 dioxide.